Available online at www.sciencedirect.com
ScienceDirect
Procedia - Social and Behavioral Sciences 174 (2015) 464 – 473
Procedia
Social and Behavioral Sciences

INTE 2014

Gender- and giftedness-specific differences in mathematical self-concepts, attributions and interests

Ralf Benölken[a]*

[a]*Westfälische Wilhelms-Universität Münster, Institut für Didaktik der Mathematik und der Informatik, Fliednerstraße 21, 48149 Münster*

Abstract

Although there is a consensus on the fact that both sexes are equally gifted across all academic domains, in Germany just like in other western and northern European countries girls are in proportion decidedly underrepresented in support programs that aim at mathematically gifted primary school-children. Thus, from the perspective of giftedness-research, it is of interest to ascertain aspects that might make possible a more differentiated identification and support. This calls for a holistic approach which among other factors may include achievement motivation. In this article a quantitative study will be reported which can clarify the significance of self-concept, patterns of attributions and interests as determinants for the identification of giftedness. Beyond that, results of a qualitative case study will be presented that indicate the effect of the identification of giftedness on the development of individual mathematical potentials.

Peer-review under responsibility of the Sakarya University

Keywords: giftedness; sex; self-concept; attributions; interests

1. Introduction

In Germany just like in other western and northern European countries girls are in proportion decidedly underrepresented in programs that foster mathematical giftedness (for a survey see Benölken, 2011). This phenomenon contradicts the consensus on the fact that both sexes are equally gifted across all academic domains (e.g. Endepohls-Ulpe, 2012). When it comes to primary school-children, aspects like gender-specific typifications of mathematical occupational fields or individual biographical decisions cannot act as possible explanations, especially

* Corresponding author. Tel.: +49 251 83 39151; fax: +49 251 83 32718.
E-mail address: rben@math.uni-muenster.de

Peer-review under responsibility of the Sakarya University
doi:10.1016/j.sbspro.2015.01.690

because there cannot be found any differences in mathematical competencies at this age (e.g. Lindberg et al., 2010), and for many years studies have indicated a decline of gender-specific differences in mathematical achievements at subsequent ages (e.g. Ma, 2010; Hyde et al., 2008). This is why it is of interest to look for aspects that improve the identification of girls' mathematical giftedness[1]. In principle diagnostics should be organized as a process considering both cognitive and co-cognitive parameters. This holistic approach focuses on a complex of different influences such as „motivation" containing "self-concepts", "attributions" and "interests" (Benölken, 2014; 2011). In this article, the significance of these factors as determinants for the identification of giftedness at primary school age will be examined by a quantitative study. Its aim is to look for boys' and girls' frequent characteristics of the mentioned factors by a comparison of four groups: boys and girls who were identified to be mathematically gifted (subsequently, they will be referred to by the acronym "img") as well as boys and girls who were not ("n-img"). Based on a survey of theoretical findings, hypotheses on the mentioned characteristics will be deduced. Afterwards, the design and the results of the study that investigated the hypotheses will be reported. Beyond that, results of a qualitative case study will be reported that indicate the effect of the identification of giftedness on the development of individual mathematical potentials. Finally, the quantitative and qualitative results will be discussed.

2. Theoretical background

The reviewed factors of motivation need to be seen in a strong interaction guided by similar factors like attitudes and both affective and environmental factors. The concurrence of all factors influences individual behaviors as a result of a decision by an expectancy-value-appreciation (Eccles et al., 1983). Therefore, motivational factors that cause positive influences on the whole complex are characterized as "functional" (otherwise "dysfunctional"). Research on the reviewed factors of motivation is mostly based on the psychological view on giftedness, which partially differs from a special mathematical giftedness (cf. note 1). The findings show, however, the significance of these factors as determinants for the identification of giftedness (in the psychological view). Therefore, they are suited to provide a basis for the intended hypotheses.

Self-concepts develop globally and domain-specifically containing both cognitive-evaluative and affective components (e.g. Shavelson et al., 1976). They can already be found at primary school age (e.g. Marsh et al., 1991). As early as at this age, gifted and non gifted children differ in their global- and domain-specific self-concepts (e.g. Rost and Hanses, 2000). In contrast to global self-concepts (in summary Rost and Hanses, 2000), there are findings about gender-specific differences in domain specific ones (e.g. Rustemeyer and Jubel, 1996). For instance, boys often show better self-concepts in mathematics (in summary Pohlmann, 2005), girls in social or verbal skills (e.g. Valtin and Wagner, 2002). Among other things, dysfunctional mathematical self-concepts are reputed to be responsible for the fact that girls at primary school age tend to engage in mathematics on a relatively small scale (e.g. Dickhäuser and Stiensmeier-Pelster, 2003; Keller, 1998). Boys and girls who were identified to be gifted do not differ in their mathematical self-concepts (Wieczerkowski and Jansen, 1990).

The concept of attributions refers to reasons that an individual provides in order to explain his or her achievements. They are divided into the dimensions of "locus of control" and "stability" (Weiner, 1986). Findings of older studies showed that as early as at primary school age and irrespectively of certain domains, i.e. especially in mathematics, girls tend to dysfunctional external-unstable attributions of success and internal-stable ones of failure. In contrast, boys tend to functional internal-stable attributions of success and external-unstable ones of failure (e.g. Rustemeyer and Jubel, 1996; Tiedemann and Faber, 1995; Kirschmann and Röhm, 1991). Contemporary studies indicate that girls more often tend to internal-unstable attributions of success, while boys still tend to internal-stable ones (e.g. Dickhäuser and Meyer, 2006). This result is also reported for gifted children who gain mathematical

[1] According to Fuchs and Käpnick (2009) "mathematical giftedness" is seen as an above-average potential regarding the criteria of Käpnick (1998). This potential is characterized by individual determinants and a dynamic development depending on inter- and intrapersonal influences in interdependence with personality traits supporting the giftedness. Therefore, diagnostics should be organized in an holistic long-term process.

success (e.g. Tirri and Nokelainen, 2011). Beyond that, gifted children generally tend to advantageous attributions more often than non-gifted children (e.g. Schütz, 2000).

According to the scientific consensus, interest is a result of an interaction that – along with adjuvant conditions – causes to focus on a long-term preoccupation with something (Prenzel et al., 1986). Even primary school-children often have a lot of interests like sports, TV, computer games or reading (in summary Pruisken, 2005). Furthermore, there can already be found gender-specific differences at this age (e.g. Hoberg and Rost, 2000): horseback riding, animals or reading seem to be "typical" interests of girls, football, technics or computer "typical" interests of boys (e.g. Fölling-Albers, 1995). Though gifted children show the same differences, they do not have any extraordinary interests compared to non-gifted children (for a survey see Pruisken, 2005). In contrast to non-gifted girls, gifted girls seem to have more interests which are supposed to be "typical" interests of boys (this is why some authors decline an interim position of gifted girls between gifted boys and non gifted girls; e.g. Stapf, 2006). In addition to that, they seem to have a larger spectrum of interests than gifted boys (e.g. Kerr, 2000).

3. Design and results of the quantitative study

3.1. Questions

In the following, the hypotheses will be presented that have been deduced from the summarized results: (1) Img girls and boys as well as n-img boys show more functional mathematical self-concepts than n-img girls. (2) Img girls and boys tend to functional, i.e. internal, attributions of mathematical success (2a.1). N-img boys more often tend to functional, i.e. internal, attributions of mathematical success than n-img girls (2a.2). Img girls and boys tend to functional, i.e. external, attributions of mathematical failure (2b.1). N-img boys more often tend to functional, i.e. external, attributions of mathematical failure than n-img girls (2b.2). (3) Img girls have a larger spectrum of interests than img boys, n-img girls and n-img boys.

3.2. Design, sample and procedure

The study adds to Benölken (2011). Operationalizations of both self-concept and attributions were extracted from a questionnaire that focuses on motivation beyond other domains and were put together with a short questionnaire that focuses on interests (the manner of operationalizing the focused factors of motivation was tested within pilot studies by Benölken, 2011). This approach is based on the infrequent identification of girls' mathematical giftedness: Existing data was used to enlarge the sample of img girls. Despite its quantitative design, the study is explorative, because established tools were not applied. The sample contains N=288 children of the third and fourth grade (132 girls, 156 boys). The subsample of img children is n=165 (66 girls, 99 boys). Children who are named as "mathematically gifted" take part in a project that fosters mathematical giftedness at the university of Münster called "math for small pundits". They were chosen by established long-term process-diagnostics that are a synthesis of standardized and non-standardized tools (cf. note 1; for details see Benölken, 2014). n=85 from this group of probands were questioned during the school year of 2012/2013 (35 girls, 50 boys). In addition to that, all children who completed the questionnaire of interests in the previous study were included, i.e. n=80 (31 girls, 49 boys), among them n=33 probands (14 girls, 19 boys) whose data about self-concept and attributions could be clearly assigned. These probands were questioned during the school year of 2008/2009 using a non-anonymized questionnaire (as opposed to subsequent questioning). The sample contains n=123 n-img primary school-children (66 girls, 57 boys) from common classes questioned during the school year of 2012/2013. The n-img group is obviously independent of the group of img children. All procedures of questioning were consistent: The children were told how to fill in the questionnaire. They completed it on their own without any time limit (no one took more than 15 minutes and no one refused to fill in the questionnaire).

3.3. Method

Apart from declaring sex, the questionnaire was anonymized. The focused factors of motivation were operationalized corresponding to the above-mentioned research results. In order to measure self-concepts by both a cognitive-evaluative and an affective aspect, the following instruction was given (all instructions were formulated in German – subsequently, English translations will be given): “Mark with a cross a statement that is proper to you: [1] I am very good at math. [2] I particularly enjoy solving difficult math-tasks.” To evaluate these items, a four-step scale was offered (“that’s not correct”, “that’s almost not correct”, “that’s almost correct”, “that’s correct”; in addition, the children could also choose “I don’t know”). Attributions for success were operationalized by the instruction: “Imagine: You solved a difficult math-problem. Why did you succeed? Because… [1] you worked really hard, [2] it was random, [3] you’re very good at math, [4] the task was simple.” Attributions for failure were analogically operationalized: “Imagine: You could not solve a difficult math-problem. Why didn’t you succeed? Because… [1] it was random, [2] the task was really difficult, [3] you’re not really good at math, [4] you didn’t work hard enough.” Just one answer was allowed to be chosen to get the strongest trend by a “forced choice”-decision. Instead “another reason” could be added for both success and failure in an open line. These answers were assigned to Weiner’s dimensions afterwards. To collect data about the number of interests, a schedule according to the above mentioned research results was composed intending to offer a large spectrum of interests. It contained the disjunct domains intellectual, sportive, general and “typical” interests of both boys and girls (for a survey see Benölken, 2014). Beyond that, further interests could be added into open lines. The instruction was: “Mark with a cross all interests that you have. In the open lines you can also note interests that are not mentioned.”

3.4. Evaluation

Statements about self-concept-items were translated into numbers from 1 (“that’s not correct”) to 4 (“that’s correct”). The coefficient of correlation as defined by Pearson between these items is .588 ($p<.001$) and the internal consistency is acceptable or even good (Cronbachs $\alpha=.73$). The items have been combined to one scale with mean values and evaluated by an analysis of variance with two factors (“giftedness” and “sex”) to find significant differences between the four groups (for remarks about requirements of the used statistical procedures see Benölken, 2014). In addition to that, η^2-values have been calculated to see the importance of both the factors and their interaction by their effect size ($\eta^2<.06$ means a small effect, $\eta^2<.14$ a medium effect and $\eta^2\geq.14$ a large effect; see Cohen, 1988). As to the evaluation of attribution-data, cross-tabs have been built containing giftedness, sex and Weiner’s dimensions. They also include standardized residua in order to point out significant differences: Values $\leq$-1.96 or $\geq$1.96 indicate an ascertainable divergence from expected frequency in each cross-tabs-cell regarding to a level of significance of $\alpha=.05$ (Eid et al., 2011). Significance of possible differences was tested using the exact Fisher-test: According to Weiner’s dimensions, attribution was operationalized by a nominal scale consisting of four values. Data of img and n-img children were evaluated independently. The chosen interest-items have been transformed into one variable containing their sum. It was evaluated by an analysis of variance with two factors (“giftedness” and “sex”).

3.5. Results

Table 1 shows averages and standard deviations of self-concept-statements. There are significant main effects on giftedness ($F(1,237)=63.39$, $p<.001$, $\eta^2=.211$) and sex ($F(1,237)=21.16$, $p<.001$, $\eta^2=.082$) as well as a significant effect of interaction between these factors ($F(1,237)=23.80$, $p<.001$, $\eta^2=.091$). Thus, there is a main effect on sex which cannot be interpreted because the averages of img boys and girls are nearly identical. As indicated by η^2-values, giftedness (strong effect of 21.1%) plays a bigger part to explain variance than interaction between giftedness and sex (medium effect of 9.1%). Therefore, img children have more functional self-concepts in comparison with n-img children, but n-img boys merely differ a little. This fact confirms hypothesis 1.

Table 1. Averages (standard deviations) of self-concept-statements.

group	boys	girls	overall
img	3.58 (.44)	3.60 (.42)	
	n=69	n=49	118
n-img	3.33 (.59)	2.58 (.87)	
	n=57	n=66	123
overall	126	115	241

Table 2 shows attribution-data of mathematical success. Hypothesis 2a.1 cannot be confirmed or rebutted because the result of the exact Fisher-test is not significant (=4.044, p=.243). In contrast, hypothesis 2a.2 was confirmed by a significant result of the exact Fisher-test (=30.137, p<.001). Compared to n-img boys, n-img girls more infrequently tend to internal-stable (-2.6 to 2.8), but more often to external-stable (2.2 to -2.4) attributions as shown by the standardized residua.

Table 2. Cross-tabs about descriptions of attributions for mathematical success.

group/sex		internal-unstable	internal-stable	external-unstable	external-stable	overall
img boys	number	21	42	2	4	69
	standardized residua	-.5	.6	.8	-.8	
img girls	number	19	23	0	6	48
	standardized residua	.6	-.7	-.9	.9	
overall		34.2%	55.6%	1.7%	8.5%	100%
n-img boys	number	25	31	1	0	57
	standardized residua	-.8	2.8	-1.2	-2.4	
n-img girls	number	38	10	6	12	66
	standardized residua	.7	-2.6	1.2	2.2	
overall		51.2%	33.3%	5.7%	9.8%	100%

Table 3 shows attribution-data of mathematical failure. Hypothesis 2b.1 cannot be confirmed or rebutted because the result of the exact Fisher-test is not significant (=3.656, p=.282). Hypothesis 2b.2 was confirmed because the result of the exact Fisher-test is significant (=19.882, p<.001). In comparison with n-img boys, n-img girls more often tend to internal-stable attributions as shown by the standardized residua (2.3 to -2.5).

Table 3. Cross-tabs about descriptions of attributions for mathematical failure.

group/sex		internal-unstable	internal-stable	external-unstable	external-stable	overall
img boys	number	15	1	16	37	69
	standardized residua	-1.0	-.2	.2	.6	
img girls	number	18	1	10	20	49
	standardized residua	1.2	.2	-.2	-.8	
overall		28.0%	1.7%	22.0%	48.3%	100%
n-img boys	number	15	0	9	33	57
	standardized residua	-.4	-2.5	1.0	1.0	
n-img girls	number	21	13	5	27	66
	standardized residua	.4	2.3	-.9	-.9	
overall		29.3%	10.6%	11.4%	48.8%	100%

Table 4 shows averages and standard deviations of the total sum of interests. There are significant main effects on giftedness ($F(1,284)=10.50$, $p=.001$, $\eta^2=.036$) and sex ($F(1,284)=86.77$, $p<.001$, $\eta^2=.234$), but there is no effect of interaction between these factors ($F(1,284)=.01$, $p=.915$, $\eta^2=.000$). As indicated by η^2-values, sex (strong effect of 23.4%) plays a bigger part to explain variance than giftedness (small effect of 3.6%). Therefore, img-girls have a larger spectrum of interests compared to both img and n-img boys on average. Hypothesis 3 is confirmed for img girls. Notwithstanding hypothesis 3, n-img girls have more interests compared with the two groups of boys on average, too.

Table 4. Averages (standard deviations) of interests' sum.

group	boys	girls	overall
img	8.68 (3.43)	12.44 (3.82)	
	n=99	n=66	165
n-img	7.44 (2.47)	11.11 (3.21)	
	n=57	n=66	123
overall	156	132	288

3.6. Retrospection

Main aspects of the deduced hypotheses have been confirmed. Within the group of n-img children, girls more often tend to have dysfunctional characteristics of self-concepts and attributions than boys. By contrast, within the group of img children, dysfunctional characteristics rarely appear, and n-img boys are very similar to this group. In addition to that, girls have independently of the identification of giftedness more often a larger spectrum of interests than boys on average.

4. Results of a case study about the effect of the identification on the individual development of giftedness

Subsequently, excerpts of a case study will be presented that focused on twins, Julia and Tobias. Their unequal developments indicate possible influences of self-concepts, attributions and interests on the development of giftedness. The study is taken from Benölken (2011; 2014). Its intention was to examine effects of both boys' and girls' characteristics of particularities that had been proven by quantitative studies before within single cases. Among other things, motivational factors, which have been regarded simultaneously with the children's environment, their physical and cognitive development as well as personal traits that might support their giftedness, were examined. The twins took part in the project "math for small pundits" (cf. chapter 3.2). Methods applied within the case studies were non-standardized tools (see Benölken, 2011 for details) including guided interviews that provide the basis of the following interpretations (the probands were interviewed in German – subsequently, English translations will be given).

4.1. Self-concepts

Julia did not show a strong preoccupation with mathematics and her giftedness did not attract any attention. From the parents' point of view, she assimilates her mathematics-achievements to other girls of the class (an often-reported phenomenon, e.g. Rohrmann und Rohrmann, 2005):

Father: For some time, we had the impression that Julia did not want to attract attention by way of successful achievements. Especially in school subjects that grab interest like math. This is why Tobias' giftedness was identified early: Giftedness in other domains such as languages is not as ostentatious as mathematical giftedness. We thought Julia explicitly assimilated her achievements to the class-average in order to avoid being second to none.

Primarily, Julia's mathematical self-concept was not as advantageous as Tobias' self-concept. For instance, she avoided situations that caused comparisons between herself and her brother believing she could not stand with his mathematical-achievements – furthermore, this feeling was affirmed by her environment. In contrast, she ascribed herself skills in other domains:

Interviewer: What do you think? Are you doing better at math or your brother?
Julia: Tobias.
Interviewer: Tobias?
Julia: In contrast I am doing better at German.
Interviewer: Are there any domains in which your skills exceed Tobias' skills?
Julia: Yes, painting and writing. Especially writing in one's best handwriting. His handwriting is unreadable.

At first, merely Tobias was chosen to take part in "math for small pundits". Caused by pragmatical reasons like looking after the children, the parents asked to allow Julia to participate, too. Subsequently, Julia's mathematical self-concept was strongly affirmed by taking part in the project. In contrast, Tobias had a positive mathematical self-concept before participating in the project. This fact led to an extraordinary engagement in mathematics accompanied by a lot of joy solving difficult mathematical tasks on his part:

Mother: At first, she was afraid that she was not able to keep up with Tobias' achievements. We advised her to check out the atmosphere of the project and to quit immediately in case she didn't like it.
Father: Now, she enjoys taking part in the project and she looks forward to every project-session.
Interviewer: What do you think? Do they wish to be absolutely sure to be able to solve math-problems?
Mother: I think they're sure to be able to. Possibly it might be influenced by Julia's self-confidence, but Tobias definitely would believe that.

In sum, the examples indicate the significance of giftedness-identification as a determinant that can influence mathematical self-concepts, because Julia's self-concept became more advantageous only after she took part at "math for small pundits": Therefore, the identification of her potential first caused that she realized her skills.

4.2. Attributions

Questioned about his attributions on mathematical achievements, Tobias took the following stance:

Interviewer: Imagine: You were not able to solve a mathematical task. Why didn't you succeed?
Tobias: I think you didn't express the task's content correctly. Same thing at school: Teachers don't explain tasks correctly. This causes a lot of mistakes and even my parents often don't know what to do.
Interviewer: You don't think it is up to you? If all tasks were explained correctly, could you solve them all?
Tobias: Maybe there are some I can't solve because I don't understand them – but nearly all tasks.
Interviewer: Imagine: You solved a mathematical task. Why did you succeed?
Tobias: I don't know.
Interviewer: Is it up to you? Did you just find a solution? Or do you think the task was too simple?
Tobias: I don't know. Usually, the tasks are absolutely simple.

Tobias attributes mathematical failure in an external-stable, i.e. functional, way (difficulty of tasks). The mentioned internal-unstable aspect ("I don't understand them") seems to be caused by an understatement-effect as a consequence of the interviewer's questioning-style. His attributions on mathematical success are ostensibly external-stable ("the tasks are absolutely simple"). The fact that he provides to be able to solve "nearly all tasks" indicates a strong confidence in his mathematical skills – this can be interpreted as a proof of internal-stable attributions on mathematical successes. In contrast, Julia took the following stance:

Interviewer:	Imagine: You could not solve a mathematical task. Why didn't you succeed?
Julia:	I remember a situation: I read a task wrongly. As a consequence, the solution was incorrect.
Interviewer:	Imagine: You solved a mathematical task. Why did you succeed?
Julia:	Because I knew the task, for instance from a book or from school.

Julia attributes mathematical failure in an internal-unstable way (effort or concentration) and success in an external-unstable way (random). Therefore, her attributions are dysfunctional.

Even Tobias' functional attributions can partially just be concluded by interpretation. The example of the twins illustrates gender-specific differences that are often reported (cf. chapter 2). Julia's dysfunctional attributions indicate that the development of functional factors of motivation might be a long-term process with img children, too – maybe especially with girls.

4.3. Interests

Tobias very early showed strong interest in mathematics. For instance, he perceived mathematical phenomena in his environment, and he occupied himself with mathematical tasks in his spare time. Julia developed interest in mathematics not until her huge potential was identified. Furthermore, it became one of several interests while she preferred artistic domains. According to that fact, she mostly likes mathematical tasks that contain artistic, creative or playful aspects (in contrast to Tobias). Though Julia's interest in mathematics developed in a positive way, mathematics kept a different significance for her and her brother:

Father:	Numbers cover Tobias' life. He always plays with numbers. By comparison, Julia's interest in numbers is less noticeable. Therefore, we didn't perceive her mathematical potential.
Interviewer:	How would you describe your children's interests in mathematics?
Mother:	Tobias' interest in mathematics is obviously in contrast to Julia's interest. She often avoids comparisons with her brother, and she doesn't want to be compared to him – just because she doesn't want to lose out.
Interviewer:	Do mathematics play an important part in your children's mind?
Father:	Just in Tobias' mind.

In sum, the examples indicate the significance of giftedness-identification as a determinant that can influence a positive development of individual interests in mathematics. Furthermore, Julia had several interests that are partially more important than mathematics in her subjective view. This fact might obstruct the development of a stronger interest in mathematics. In contrast, Tobias focused strongly on mathematics.

4.4. Retrospection

The reported case study illustrates the possible significance of the regarded factors as determinants on the development of giftedness. Just after her huge mathematical potential was identified, a more functional self-concept and a stronger interest in mathematics emerged with Julia. The factors of motivation, however, are still not completely developed functionally as shown by her attributions. Therefore, giftedness-identification seems to have a strong effect on the development of advantageous motivational factors. As to Julia's attributions, the inverted interpretation might be important regarding processes of diagnostics: Dysfunctional characteristics of motivational factors might obstruct the identification of huge potentials – for instance, they could be obscured by different interests. In this manner, the rare identification of girls' mathematical giftedness might be partially clarified if such characteristics could be found with girls who are mathematically gifted, but not identified.

5. Discussion

Img girls and boys (in concordance with Wieczerkowski and Jansen, 1990) as well as n-img boys show functional mathematical self-concepts more often than n-img girls. Within the img group, there were not found any significant differences for attributions of both mathematical success and failure. Img girls and boys did not differ within the examined sample: They primarily attribute success internally and failure externally, i.e. functionally. This fact might be interpreted as proof of hypotheses 2a.1 and 2b.1 (in contrast to Wieczerkowski and Jansen, 1990; similar to Tirri and Nokelainen, 2011), but this assumption has to be assured by further studies. The study showed significant differences in n-img childrens' attributions of both mathematical success and failure. N-img girls more infrequently attribute success in an internal-stable way, but more often in an external-stable way than boys. Compared to boys, their attributions of failure tend to be internal-stable. Therefore, n-img girls tend to have dysfunctional attributions, while n-img boys are similar to img children. Finally, img (and n-img) girls have more interests than img and n-img boys on average (similar to Kerr, 2000). Within the n-img group, girls more often show dysfunctional characteristics of the regarded motivational factors than boys. By contrast, within the img group, dysfunctional characteristics rarely appear, and n-img boys are very similar to this group. Furthermore, the reported case study indicates a strong significance of motivational factors as determinants that influence the development of giftedness.

The results indicate that both functional self-concepts and attributions can be found – independently of the identification of giftedness – more often with boys. This might cause more efficient diagnostics of their giftedness because a teacher might perceive such characteristics primarily. By contrast, dysfunctional characteristics might lead to the fact that children do not develop a stronger preoccupation with mathematics. This might also apply to dysfunctional characteristics shown by children who have a huge potential that might be more difficult to identify. The findings of course are not suited to predict how self-concepts and attributions are developed with girls who are mathematically gifted, but not identified. The fact that n-img girls show dysfunctional characteristics more often than n-img boys and the results of the case study that indicate a strong impact of giftedness-identification on the development of giftedness lead to a thesis that must be put forward with great care: Huge mathematical potentials might be identified more infrequently with girls than with boys because girls more often show such dysfunctional characteristics. In that way, the results make a contribution to explain mathematically gifted girls' rare identification (for practical implications see Benölken, 2014).

Looking at the number of img girls using data of Benölken (2011) was useful because thus a suitable subsample could be ensured despite their rare identification. Moreover, the sample, especially the subsample of img children, is nothing more than an insufficient image of population, and its representativeness has to be seen as limited. In principle, the questionnaire was suited to the aims of the study. Moreover, the questionnaire also is suited for a pragmatical use in classrooms because its design is appropriate for children, and it can be completed in a short time. However, self-concept, attributions and interests are strongly reduced in their conceptions, and their evaluation depends on very simple measurements. In addition, the external validity of the findings cannot be judged because established tools that regard criteria of quality were not used. In sum, the study has obvious limitations, and it is to be seen as an explorative one (for details see Benölken, 2014). Subsequent studies are well-advised to use established tools to prove the reported results and consider further motivational factors like attitudes. Furthermore, the significance of motivational factors as influences on the development of giftedness should be examined in subsequent qualitative studies.

References

Benölken, R. (2014). Begabung, Geschlecht und Motivation. Erkenntnisse zur Bedeutung von Selbstkonzept, Attribution und Interessen als Bedingungsfaktoren für die Identifikation mathematischer Begabungen. *Journal für Mathematik-Didaktik, 35(1),* 129–158.

Benölken, R. (2011). *Mathematisch begabte Mädchen. Untersuchungen zu geschlechts- und begabungsspezifischen Besonderheiten im Grundschulalter.* Münster: WTM.

Cohen, J. (1988). *Statistical Power for the Behavioral Sciences* (2nd ed.). Hillsdale: Lawrence Erlbaum.

Dickhäuser, O. & Meyer, W.-U. (2006). Gender Differences in Young Children's Math Ability Attributions. *Psychology Science, 48(1),* 3–16.

Dickhäuser, O. & Stiensmeier-Pelster, J. (2003). Wahrgenommene Lehrereinschätzungen und das Fähigkeitsselbstkonzept von Jungen und Mädchen in der Grundschule. *Psychologie in Erziehung und Unterricht, 50(2),* 182–190.

Eccles, J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J., & Midgley, C. (1983). Expectancies, Values and Academic

Behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 26–43). San Francisco: Freeman.
Eid, M., Gollwitzer, M. & Schmitt, M. (2011). *Statistik und Forschungsmethoden* (2nd ed.). Weinheim, Basel: Beltz.
Endepohls-Ulpe, M. (2012). Begabte Mädchen und Frauen. In H. Stöger, A. Ziegler & M. Heilemann (Eds.), *Mädchen und Frauen in MINT. Bedingungen von Geschlechtsunterschieden und Interventionsmöglichkeiten* (pp. 103–132). Berlin: Lit Verlag.
Fölling-Albers, M. (1995). Interessen von Grundschulkindern. Ein Überblick über Schwerpunkte und Auslöser. *Grundschule, 27(6),* 24–26.
Fuchs, M. & Käpnick, F. (2009). *Mathe für kleine Asse. Empfehlungen zur Förderung mathematisch interessierter und begabter Kinder im 3. und 4. Schuljahr* (Vol. 2). Berlin: Cornelsen.
Hoberg, K. & Rost, D. H. (2000). Interessen. In D. H. Rost (Ed.), *Hochbegabte und hochleistende Jugendliche. Neue Ergebnisse aus dem Marburger Hochbegabtenprojekt* (pp. 339–365). Münster et al.: Waxmann.
Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B. & Williams, C. C. (2008). Gender Similarities Characterize Math Performance. *Science, 321,* 494–495.
Käpnick, F. (1998). *Mathematisch begabte Kinder.* Frankfurt am Main et al.: Peter Lang.
Keller, C. (1998). *Geschlechterdifferenzen in der Mathematik: Prüfung von Erklärungsansätzen.* Zürich: Zentralstelle der Studentenschaft.
Kerr, B. (2000). Guiding Gifted Girls and Young Women. In K. A. Heller, F. J. Mönks, R. J. Sternberg & R. F. Subotnik (Eds.), *International Handbook of Giftedness and Talent* (2nd ed., pp. 649–657). Amsterdam et al.: Elsevier.
Kirschmann, K. & Röhm, A. (1991). Schulische Leistungsangst, Attribution und Leistung unter Berücksichtigung der Aspekte Geschlecht und Schultyp. *Zeitschrift für Differentielle und Diagnostische Psychologie, 12(3),* 177–184.
Lindberg, S. M., Hyde, J. S., Petersen, J. L. & Linn, M. C. (2010). New Trends in Gender and Mathematics Performance: A Meta-Analysis. *Psychological Bulletin, 136,* 1123–1135.
Ma, X. (2010). Gender Differences in Mathematics Achievement. Evidence from Regional and International Student Assessments. In H. J. Forgasz, J. Rossi Becker, K.-H. Lee & O. B. Steinthorsdottir (Eds.), *International Perspectives on Gender and Mathematics Education* (pp. 225–248). Charlotte, NC: Information Age Publishing.
Marsh, H. W., Craven, R. G. & Debus, R. (1991). Self-concepts of Young Children 5 to 8 Years of Age: Measurement and Multidimensional Structure. *Journal of Educational Psychology, 83,* 377–392.
Pohlmann, B. (2005). *Konsequenzen dimensionaler Vergleiche.* Münster et al.: Waxmann.
Prenzel, M., Krapp, A. & Schiefele, H. (1986). Grundzüge einer pädagogischen Interessentheorie. *Zeitschrift für Pädagogik, 32(2),* 163–173.
Pruisken, C. (2005). *Interessen und Hobbys hochbegabter Grundschulkinder.* Münster et al.: Waxmann.
Rohrmann, S. & Rohrmann, T. (2005). *Hochbegabte Kinder und Jugendliche. Diagnostik - Förderung - Beratung.* München et al.: Ernst Reinhardt.
Rost, D. H. & Hanses, P. (2000). Selbstkonzept. In D. H. Rost (Ed.), *Hochbegabte und hochleistende Jugendliche. Neue Ergebnisse aus dem Marburger Hochbegabtenprojekt* (pp. 211–278). Münster et al.: Waxmann.
Rustemeyer, R. & Jubel, A. (1996). Geschlechtsspezifische Unterschiede im Unterrichtsfach Mathematik hinsichtlich der Fähigkeitseinschätzung, Leistungserwartung, Attribution sowie im Lernaufwand und im Interesse. *Zeitschrift für Pädagogische Psychologie, 10,* 13–25.
Schütz, C. (2000). Leistungsbezogene Kognitionen. In D. H. Rost (Ed.), *Hochbegabte und hochleistende Jugendliche. Neue Ergebnisse aus dem Marburger Hochbegabtenprojekt* (pp. 303–337). Münster et al.: Waxmann.
Shavelson, R. J., Hubner, J. J. & Stanton, G. C. (1976). Self-concept: Validation of Construct Interpretations. *Review of Educational Research, 46,* 407–441.
Stapf, A. (2006). *Hochbegabte Kinder. Persönlichkeit, Entwicklung, Förderung* (3rd ed.). München: Beck.
Tiedemann, J. & Faber, G. (1995). Mädchen im Mathematikunterricht: Selbstkonzept und Kausalattribution im Grundschulalter. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 27(1),* 61–71.
Tirri, K. & Nokelainen, P. (2011). The Influence of Self-Perception of Abilities and Attribution Styles on Academic Choices: Implications for Gifted Education. *Roeper Review, 33,* 26–32.
Valtin, R. & Wagner, C. (2002). Wie wirken sich Notengebung und verbale Beurteilung auf die leistungsbezogene Persönlichkeitsentwicklung aus? In R. Valtin (Ed.), *Was ist ein gutes Zeugnis? Noten und verbale Beurteilungen auf dem Prüfstand* (pp. 113–137). Weinheim: Juventa.
Weiner, B. (1986). *An Attributional Theory of Motivation and Emotion.* New York: Springer.
Wieczerkowski, W. & Jansen, J. (1990). Mädchen und Mathematik: Geschlechtsunterschiede in Leistung und Wahlverhalten. In W. Wieczerkowski & T. Prado (Eds.), *Hochbegabte Mädchen* (pp. 134–151). Bad Honnef: Bock.